



# AIR WAR COLLEGE – AIR UNIVERSITY

## IMPLICATIONS OF CROSS DOMAIN FIRES IN MULTI-DOMAIN BATTLE

By

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## **Biography**

Colonel Javier C. Soria entered the US Army in 1996 as a graduate of the Fresno State University of California ROTC program. He is an air defense artillery officer with multiple tours to various theaters and functional component commands. Following his initial overseas tours to PACOM and CENTCOM AORs, he served in several staff positions as a Tactical Director/Fire Direction specialist and Electronic Missile Maintenance Officer/Evaluator, functioning on multiple air defense weapons systems. He then attended Command and General Staff College at Fort Leavenworth, Kansas, subsequently served in both S-3 Operations and Executive Officer positions in deployed CENTCOM combat environments. Following S3/XO assignments, COL Soria was assigned to the Department of the Army Staff, G-3/5/7, Pentagon, and served as a Branch Chief for the Army Readiness Division. Following his Pentagon tour, he took command of 5<sup>th</sup> Battalion, 52<sup>nd</sup> Air Defense Artillery, Fort Bliss, Texas. Upon relinquishing battalion command, COL Soria served as the Deputy Operations Chief, Joint Planning Support Element Operations Group, of the Joint Enabling Capabilities Command, USTRANSCOM, Norfolk, Virginia. He is currently a student at the Air War College at Maxwell Air Force Base, Alabama.

## **Abstract**

Warfare of the future has changed the way we must fight. For several years, US forces have encountered conflicts primarily in the air and land domains. Overtime, military forces faced many operational challenges and obstacles while fighting within these domains, ultimately attempting to counter the threat capabilities by achieving superiority in both land and air. Beginning in the early 1970's, the US military developed, tested and formalized a concept, known and executed, as AirLand battle to counter the Soviet conventional threat during the Cold War era. Adversaries saw the success of AirLand battle and sought ways to fracture the concept.

Today, as adversaries leverage technological advances, the concept of AirLand battle is ever evolving, and for the US ability to maintain the same level of success as the AirLand battle of the past, their new concept must be focused on multiple domains with the necessity of operating in a joint force capacity. AirLand battle is no longer conducive to meeting the threats or defeating the challenges posed by today's enemy. As such, in a rapidly changing and demanding environment, I would contend that the need to enhance fires capability across all domains to achieve optimal military effectiveness against an advanced and capable adversary is imperative for future joint operations. The aim of this paper will be to analyze the implications of cross domain fires in multi-domain battle (MDB). Research and evaluation will consist of examining the operational environment, MDB concept and cross domain fires, service fires capabilities and historical analysis of Coastal Artillery's cross domain capabilities. Additionally, this paper will focus on emerging threats from state and non-state actors, concluding with recommendations to enhance cross domain fires synergy and leveraging advanced technologies to integrate and synchronize fires across joint services operating in a multi-domain battle environment.

A critical factor to comprehend why we must change the way we fight, is the significant understanding of the current and future operational environment and how it has changed since past conflict. As stated in the Joint Operating Environment 2035, “The future security environment will be defined by twin overarching challenges. A range of competitors will confront the United States and its global partners and interests. Contested norms will feature adversaries that credibly challenge the rules and agreements that define the international order. Persistent disorder will involve certain adversaries exploiting the inability of societies to provide functioning, stable and legitimate governance. It is these confrontations that involve contested norms and persistent disorder that are likely to be violent, but also include a degree of competition with a military dimension, short of traditional armed conflict”<sup>1</sup> The significance of the operational environment indicates the geographical contests and conditions surrounding the United States. This new environment has dramatically changed the operational course for the US. The spectrum of commitments and reassurances by the United States to our international allies will be tested moving forward, creating pressures to maintaining stability, security, and protection of vital interests universally worldwide. This new environment changes the dimension of the battlefield. Where once the battlefield was objective’s based, it is now based on area control and is no longer restricted to the two-dimensions that the US military is accustomed to fighting in.

In accordance with the projected trends occurring in the forthcoming security environment, “Warfare in 2035 will be defined by six contexts of future conflict. In 2035, the Joint Force will confront *Violent Ideological Competition* focused on the subversion or overthrow of established governments. *Threatened U.S. Territory and Sovereignty* will become increasingly prevalent as enemies attempt to coerce the United States and its citizens.

*Antagonistic Geopolitical Balancing* by capable adversaries will challenge the United States over the long term and place difficult demands on the Joint Force over a wide area of the globe. Intimidation, destabilization, and the use of force by state and non-state actors alike will result in *Disrupted Global Commons* and *A Contest for Cyberspace*. Internal political fractures, environmental stressors, or deliberate external interference will lead to *Shattered and Reordered Regions*. Each context of future conflict poses a troubling problem space for the Joint Force.”<sup>2</sup>

Historical conflicts against formidable enemies has certainly challenged US operational approaches in the conduct of war. From global conventional wars in World War II, to a dynamic shift of unconventional warfare exercised in Vietnam, a limited combat air power strategy employed in Kosovo, to an overwhelming conventional air and ground war campaign waged in the Gulf War, the operational warfare tactics continues to change into the future. As further conflicts and aggression endures across the world, the US must continue to maintain a watchful eye on new and rising set of adversarial forces. The United States cannot discount the enemies of our past, but at the same time must take into account the new and emerging enemies that continue to pose a threat to our current and future operational challenges. The challenges that face the United States are broad from near peer competitors, to transnational terrorists and cyber network attacks.

Currently, the specific focus for the US in monitoring the military advances of enemies across the globe is centered around the analysis of 4 plus 1, state actors and non-state actors identified as China, Russia, Iran, North Korea, and Violent Extremist Organizations (VEOs). In analyzing China, the state desires to modernize their military and advance their power base regionally. Based on their desire to build stable relationships, they have not called themselves out to be America’s number one threat. However, they continue a “modernization program that is

designed to improve the capacity of their armed forces, with the ability to fight and win short duration, high intensity conflicts.”<sup>3</sup> China’s most concerning developments are the aggressive efforts to deny US advances in space and cyberspace operations while “developing anti-satellite capabilities, and integrating cyber into all aspects of their military planning while developing sophisticated missiles and air defenses as part of an effort to challenge the United States’ ability to project power.”<sup>4</sup> Surrounding the critical sea transit lanes of South China Sea, China will seek to curtail freedom of navigation by positioning military assets to employ combat power projection across neighboring islands onto vital sea lines of communication. “These emerging Chinese capabilities also highlight the need for Army Forces to project power from land into the air, maritime, space and cyberspace domains.”<sup>5</sup> Although China is not American’s number one threat right now, I would contend that China is America’s long term threat, a National Security threat and an economic threat. America cannot lose the sight of this growing concern and must plan for the possibility of future conflict with China.

To understand the challenges that the United States faces in more simplistic terms, we can briefly look at modernization. Over the past 15 years the US military has been focused on fighting the counter-terrorism and counter-insurgency (COIN) threat in Iraq and Afghanistan. During this time, there have been no major modernization efforts being executed by the US Army, external to modifications in support of the COIN fight. However, during this same period, Russia has developed the T90 and the T14 Armada tank. The T14 Armada tank has active protection, an unmanned turret and a cannon that can launch long range missiles. Other adversaries like Russia are investing in research and development in fields such as directed energy weapons, rail guns, radio frequency weapons and ways to exploit “the internet of things.” On the current glide path, the Army and the Joint Force will have reduced superiority or no

superiority at all in close combat overmatch. Additionally, Russia has focused on jamming capabilities that have shown to have an impact on Air Defense forces. In the current on-going conflict between Russia and Ukraine, “Russia is using ground-based air defenses to dominate air in Eastern Ukraine. Russia has built air defense systems such as the S-300 and S-400, noted as best in the world, in order to maintain air superiority.”<sup>6</sup> Moreover, Russia’s military use of inexpensive drones in Ukraine to facilitate targeting for follow on heavy artillery barrage have resulted in positive and lethal effects.

Another threat focus for the US is the attention stemming from Iran as an emerging state actor. Iran will continue to be an international player with its intent to reach regional hegemony status in the Middle East. The state continues to modernize its military capability across all domains in order to enhance its operational and strategic reach. “Iran’s overall defense strategy relies on a substantial inventory of theater ballistic missiles capable of reaching as far as southeastern Europe...and has publicly stated it intends to launch a space launch vehicle capable of intercontinental ballistic missile ranges, in addition, the state is advancing other military capabilities such as its maritime and land assets...faster, more lethal surface vessels, growing its submarine force, expanding cruise missile systems, and increasing its presence in international waters...furthermore, are enhancing their land-based radar networks and long-range surface to air missile systems.”<sup>7</sup> Additionally, Iran continues to develop their cyber capability that will ultimately reinforce their influence and power across the Middle East.

In viewing North Korea threat capabilities, the state remains an unpredictable threat to the US and its allies. Of significance is North Korea’s relationship with China based on its status as a failing state. “North Korea is expanding its nuclear arsenal and improving its ballistic force to compliment an aging but still large and capable conventional force. Their military possess



cyber and chemical, biological warfare capabilities.”<sup>8</sup> As tensions surrounding the Korean peninsula continues to emerge, the regime’s efforts of advancing its nuclear and missile programs elevates the concerns for the US and bordering states. North Korea’s strong-minded approach of attaining more military capabilities and progressive actions with its nuclear status has heightened levels of security and stability risks within the region and brings vital awareness for US territories being truly threatened.

In addition to these major state powers, non-state actors such as ISIL, Al Qaeda, Boko Haram and other violent extremist organizations are another threat that will remain a challenge to US military operations and capacity. These violent groups continue to seek ways to enhance unconventional tactics and utilize all aspects of technology to attain a level of capability and resources that can cause disruption and devastation towards opposing forces. The aggressive and deadly intentions exercised by these non-state actors will continue to retain a transnational attack capability that will pose difficult obstacles for US forces and allies conducting military operations.

As the aforementioned threats have been discussed, the advancement of near peer adversaries’ battlespace reach is also to be taken into serious consideration. Significant military gains from Russia, China, North Korea and Iran have spiraled upward specifically within the concentration of Anti-Access/Area Denial (A2/AD). The emerging warfighting technological effects put forth by these states have no doubt placed strong emphasis on the intent for US to have difficulty in advancing its deployed capabilities (power projection) into theater. Subsequently seeking to establish an overwhelming military advance of having overmatch, capable of seizing the initiative.

Threat analysis pointed above with major powers enhancing their military capabilities such as “China’s investments in ballistic and cruise missiles, submarines, air defenses and counter-maritime forces focused on East Asian littoral’s contested nature...in addition to, Russia’s growing A2/AD capabilities and strategies to contest landmass in Europe’s east...probing over the north Atlantic region, testing defenses at sea, in the air, and on land,”<sup>9</sup> continues to reinforce the US military strategy to overcome these challenges when attempting to attain operational access and freedom of action against technologically advanced adversaries. Overall, these major state actors’ evolving capabilities to successively target, fix and launch strikes resulting in effective lethality should be considerably captured across all levels of wartime planning and execution. The aggressive, sophisticated and upgraded efforts placed on A2/AD systems and networks from countries like Russia, China, and even Iran, will challenge the Joint Force’s ability to achieve domain superiority, as now these countries are assuring that all domains will become contested across the battlespace.

“Military power is Joint Power.”<sup>10</sup> As such, the Army, Marine Corps, Air Force and Navy are developing a new joint concept in order to adequately meet the challenges of the future threat. General Mark A. Milley, 39<sup>th</sup> Chief of Staff of the United States Army, best summarized the future challenge when he stated “Warfare in the future will involve transporting, fighting, and sustaining geographically dispersed Army, Joint, and Multinational Forces over long and contested distances, likely into an opposed environment and possibility against a technologically sophisticated and numerically superior enemy. All domains will be viciously contested, and both air and maritime superiority- which have been unquestioned American Advantages for at least 75 years---will no longer be a given.”<sup>11</sup> In order to be able to effectively operate and counter an

allusive enemy's capabilities, the joint force must begin executing a new joint concept. This joint concept is Multi-Domain Battle.

When AirLand battle first surfaced as a concept, we knew the capabilities and limitations of our enemy to include the terrain that we would be contending with throughout operations. There were only two viable domains that overlapped, air and land. This concept signaled for avoiding common interference of procedures and actions conducted at the tactical and operational levels. What this concept did not carry out, was allow for the synchronization of Joint Combined Arms Operations in a modern operating environment. We can anticipate the future but cannot predict it. What came about was an understanding of a more adaptive enemy capable of operating across five domains- Land, Air, Maritime, Cyber/EW and Space. In addition to an adaptive enemy, terrain will also be a major concern. Terrain can be rural or urban (with the complication of megacities), and requires joint services to have seamless integration at all levels of war, across all five domains.

“Multi-Domain Battle is an effort to maintain US military dominance by reimagining joint operations...requires flexible and resilient ground formations that project combat power from land into other domains to enable joint force freedom of action, as well as seize positions of relative advantage and control key terrain to consolidate gains.”<sup>12</sup> Multi-Domain Battle integrates joint, interorganizational and multinational capabilities resulting in increasing domain superiority opportunities for the joint force. This concept, and new way of thinking, stresses the need to enhance fires capability across all domains to achieve optimal military effectiveness over an increasingly advance and capable adversary and is imperative for future conduct of joint military operations.

As part of Multi-Domain Battle, the Joint Force is pursuing a Cross-Domain Fires capability- a concept previously referred to as multi-access fires. The concept intends to enhance synchronization and integration within services' fires capabilities to enable freedom of maneuver across all domains. Cross Domain Fires is "the employment of joint and combined mutually supporting lethal and nonlethal fires across all domains to achieve effects designed to create multiple dilemmas for the adversary, achieve overmatch and enable joint combined arms maneuver."<sup>13</sup> The delivery of cross-domain fires will greatly improve joint force operations that will allow the decisive advantage to take shape favorably for US forces against adversaries. As Admiral Harry Harris, Commander US Pacific Command, recently stated "land forces (Army) must be able to sink ships, neutralize satellites, shoot down missiles, and damage the enemy's ability to command and control its forces."<sup>14</sup> Admiral Harris contends that "A combatant commander must be able to create effects from any single domain to targets in every domain" and that "we must be able to execute joint operations across far more domains that planners accounted for in the past. We need a degree of 'jointness' where no domain has a fixed boundary."<sup>15</sup>

Currently, US military services are limited with their ability to conduct Cross-Domain Fires, specifically in a synchronized Joint Force capacity across all domains. Land-based capabilities from Army and Marine Corps services have displayed proven effectiveness against adversaries in a conventional warfare setting, however, they are not operationally focused in a multi-domain type operations capable of achieving optimal cross domain fires effects. For the Army, artillery organizations from Air Defense and Field Artillery are main formations to employing fires capabilities. Theater level Air and Missile Defense batteries such as the Patriot and Terminal High Altitude Area Defense (THAAD) have key defensive weapon systems

primarily employed to counter enemy long-range Tactical Ballistic Missiles and Air Breathing Threats threatening critical assets, namely airbases, ports, command and control (C2) networks and population centers. Another land-based capability for the Army is the Army Tactical Missile System (ATACMS), a deep strike surface-to-surface munition system capable of engaging enemy ground targets such as C2 and ISR nodes, ground based early warning radar sensors, and rocket/missile launchers. For the Marine Corps, its amphibious operations and land capabilities consist of the High Mobility Artillery Rocket System (HIMARS) launchers, capable of firing rockets and the ATACMS as well, however, these missile systems have a short-range distance strike against enemy engagements.

The maritime strike capabilities of the Navy such as the Tomahawk Land Attack Missile (TLAM) and the Harpoon are lethal weapons that have been used successfully in past conflicts. The conventional, long-range TLAM proved its effectiveness during the Gulf War of 1991 with successful land attack operations against high value enemy C2 and air defense targets. The Harpoon missile (also launched from Air Force) provides an effective warfare capability of anti-ship and land attack strikes on enemy sea vessels and land targets. Overall, each military service has unique capabilities to effectively operate in various domains, ultimately engaging designated enemy targets, however, as adversaries emerge with sophisticated countermeasures to degrade and disrupt strike capabilities, sensor networks and precision guided munitions, the aim for US military services is to build a capability that best synchronizes and integrates cross domain fires in multi-domain operations.

As the US seeks to advance its military capabilities to achieve cross-domain effects, one significant aspect to support this aim is through the employment of land-based assets operating in cross domain denial type operations. In viewing the historical warfare capabilities captured in

the case study of Coastal Artillery, the US Army played a vital role during the execution of cross-domain denial actions prior to the engagements of the two World War periods.

Throughout numerous eras, the US Army leveraged various coastal artillery assets to execute cross-domain denial operations within large built-in military strongholds and littoral shorelines. These unique land based capabilities employed against enemies, effectively disrupted inland advancements and sea lane activities.

In October 2014, Secretary of Defense Chuck Hagel distinctly highlighted the Army's capacity of assuming a larger role to future missions surrounding Asia-Pacific, "the US Army has a history of using land-based capabilities to deny adversaries freedom of movement and action at sea...massive forts and coast artillery emplacements that still overlook our nation's strategic waterways are a testament to how seriously the Army took this mission before the World Wars drew the United States into an era of expeditionary operations...the Army's existing offensive fires and air and missile defense capabilities could provide a jumping-off point for more robust cross-domain denial capabilities."<sup>16</sup> The existing land-based systems depicted within the Army and Marine Corps fires community can certainly have a foreseeable method of employing cross-domain denial actions as illustrated by past Coastal Artillery assets. Artillery firing batteries equipped with "HIMARS and rocket and missile launch systems (MLRS) could acquire modifications that produces a land-based sea denial capability...with interchangeable payload pods and precision strike capability, all the batteries really lack is a long-range anti-ship missile...if properly armed with extended range land attack munitions, the batteries could hold at risk bases, staging areas, launchers, and other high value targets deep within enemy territory."<sup>17</sup>

As highlighted in the threat analysis of this paper, the enemies military capabilities are advancing in rapid stages, specifically with their A2/AD systems, across various domains that

will negate freedom of maneuver actions. However, utilizing some techniques from this study of Coastal Artillery can create windows of opportunity for military forces to counter the threat of A2/AD, attain the necessary operational access and freedom of maneuver across the respective domains of air, land and sea. As LTG H.R. McMaster, previous Director of Army Capabilities Integration Center, points out, the enemies will continue its adaptiveness and effective employment of emergent capabilities, “the enemies will take cover in cities, forests, and other complex terrain, with jammers to blind our long-range sensors and missiles to keep our aircraft at a distance...that means we’re going to fight close combat...we’re going to have to close with and destroy the enemy.”<sup>18</sup> US forces must anticipate that domains will be strongly contested, ultimately posing challenges for favorable conditions to be reached across time and space within the area of operations.

As the paper has outlined several US service fires capabilities, highlighting some limitations for effectively operating in a Multi-Domain Battle, some emerging force developments and key upgrades have been underway by services that will provide alternative solutions to improving capabilities of conducting Cross-Domain Fires against elusive and capable adversaries. The ATACMS for the Army and Marines are pushing tests for further upgrades to be installed to extend strike capability. The legacy ground-based missile has proven its effectiveness throughout past battles, an extension to its range with upgrades on precision guidance will boost the lethality of the rocket system for the military services continued use against adversaries. As the upgrades for existing artillery weaponry continues, the Army is leveraging other possible technology to increase its long-range artillery, capable of synchronizing into the Multi Domain Battle concept. New technological advances such as the “Long-Range Precision Fires (LRPF) could become a linchpin of the Army’s approach to multi

domain battle, extending ground-based artillery's reach not only to unprecedented ranges – hitting distant targets once reserved for airstrikes – but out to sea.”<sup>19</sup> The emerging developments from the LRPF will certainly provide improvements to long-range strike capability for the US and more importantly, increase fires capabilities for fellow military services operating in a joint capacity, able to counter an advanced adversary's A2/AD capability.

The Navy's latest fielded technology of the Naval Integrated Fire Control – Counter Air (NIFC-CA) capable of attacking imminent enemy targets at long range distances is a positive advancement for increasing lethality over extensive battlespace. Although there is a lot to be done in order to prove this joint concept of Multi-Domain Battle, DoD's leadership is confident in the end state. According to Admiral Harris, “The Army has a tremendous air defense capability and the Navy has this incredibly powerful [NIFC-CA] capability. These two systems ought to be talking to each other so they can be complementary and work in order to give us superiority on the battlefield.....I want them to deliver a missile on target, and I want them to do it interchangeably...so the E-2D [Advanced Hawkeye] and the Aegis destroyer and the Army counter-air are integrated together. I think that is the way of the future.”<sup>20</sup>

As services continue to press forward with these developments and upgrades, some key recommendations in my perspective for enhancing Cross-Domain Fires across joint services operating in a Multi-Domain Battle environment include actions from advancing military service efforts with participation in joint/multinational exercises (Pacific Pathways, Northern Edge, Eager Lion, Ulchi Freedom Guardian, etc), limit the scaling down execution of virtual and table-top exercises, and solidify the fast upgrades and modifications that can occur now with existing firepower capabilities, specifically with land-based units. Additionally, I would offer recommendations to look towards a realignment of land-based Air and Missile Defense batteries



to be attached to maneuver battalions and brigades, providing a layered defense with other artillery ground-based units, reinforcing freedom of action and the advance recommendations to achieve Cross Domain Synergy, creating favorable conditions like facilitating Maritime assets through key choke points across the sea domain. Moreover, the ability to enhance military dominance by having substantial maneuver land-based power (cross domain fires) will presumably provide an even more decisive advantage to Joint Force Entry Operations setting the stage to maintain offensive operations for maintaining a competitive advantage over our adversaries.

Allies and coalition partners continue to reinforce the dimensions of operating in a new joint concept, placing emphasis on multi domain battle. Director of the Australian Armies War Research Centre, Dr. Albert Palazzo, predicts...“land-based systems have far-reaching effects into the sea and aerospace domains. The significance is that command of the sea or air is no longer a function of being the dominant maritime or air power in a region...the prerequisite for the command of the sea will be command of the land. If navies are to maneuver in waters overwatched by anti-access weapons, they can only do so if friendly forces control both their own territory and also dominate the land of their adversary.”<sup>21</sup> Recent collaborative white paper submission from US senior service leadership of the Army and Marine Corps highlights the development of a highly maneuverable land force, tailored with a fully-integrated multi domain capability. The construct of this new flexible and tailored future land force will have capabilities from multiple services, ultimately, capable of conducting integrated multi-domain operations. This new developmental multi-service force would enhance US warfighting capability across domains, create more dilemmas for our adversary’s efforts of contesting the operating

environment/deny freedom of action, and strengthen our joint capacity of maintaining military dominance.

In conclusion, our world is certainly a complex one, and the challenges we face today were not the same challenges we faced for the past sixteen years. Before we can execute Multi-Domain Battle and employ Cross-Domain Fires, we must first understand the concept and identify the capability gaps. Capability gaps will be identified during exercises and war games. The Army is only one service that has this enormous problem to solve, and by no means can they do it alone. The Army Capabilities Integration Center uses the concept of Think, Learn, Analyze and Implement, as a means of identifying solutions to service identified capability gaps. By using the Army's concept of Think, Learn, Analyze and Implement model – both material and non-material solutions can be identified. I would recommend DoD use this same model in order to solidify the solution to the Multi-Domain Battle dilemma and the effective integration of Cross-Domain Fires that the US military will face in the very near future. Currently, we (Army/USMC) are conducting a study on the concept of Multi-Domain Battle (Think), once the joint services believe they understand the concept, the concept will be executed in a joint exercise (NTC, JRTC, Eager Lion, Unified Quest, etc). The Services should execute in a focused and collaborative manner, in order to apply the concept (Learn). Following the exercise(s), analysis should be conducted to identify modifications, requirements, priorities and investments required for the future force (Analyze). Upon completion of the analysis, the services should implement the plan by developing DOTMLPF (doctrine, organization, training, material, leadership and education, personnel and facilities) solutions in order to improve future operational forces and their ability to execute Multi-Domain Battle/Cross-Domain Fires. (Implement). In an unpredictable world, with capable and elusive adversaries, the US military

must continue to make strides in performance and capability and must do so, as if tomorrow depended on it. “The U.S. military along with allies and partners will project power across multiple domains to decisively defeat the adversary by compelling it to cease hostilities or render its military incapable of further aggression.”<sup>22</sup> As adversaries continue to seek advancements in the field of battle - effectively employing military power across multiple domains, the ability to maintain a decisive advantage becomes increasingly challenging for the United States. The future joint warfighting advances through the Multi Domain Battle concept, amplified with increased land power fires capability presents a positive solution to counter adversarial enhanced capabilities. US military forces coming onboard to improve joint integration with the ability to employ effective Cross Domain Fires in a multi domain environment, will ultimately create a more synergistic, joint and combined lethal force across the battlespace, decisively creating favorable conditions for military services to achieve operational success.

## ENDNOTES

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<sup>1</sup> *Joint Operating Environment (JOE) 2035: The Joint Force in a Contested and Disordered World*, 14 July 2016, p. ii.

<sup>2</sup> JOE 2035, p. iii.

<sup>3</sup> U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, The U.S. Army Operating Concept (AOC), dated 7 October 2014, p. 12.

<sup>4</sup> TRADOC Pamphlet 525-3-1, AOC, p. 13.

<sup>5</sup> TRADOC Pamphlet 525-3-1, AOC, p. 13.

<sup>6</sup> Kris Osborn, "Cross-Domain Fires: US Military's Master Plan to Win the Wars of the Future," *The National Interest*, July 19, 2016, p. 2, Retrieved on 2 December 2016, <http://nationalinterest.org/blog/the-buzz/cross-domain-fires-us-militarys-master-plan-win-the-wars-the-17029?page=2>.

<sup>7</sup> LTG Vincent R. Stewart, (USMC), "Worldwide Threat Assessment: Armed Services Committee US House of Representatives," *Defense Intelligence Agency*, February 3, 2015, p. 15, Retrieved on 2 December 2016, <http://www.dia.mil/News/Speeches-and-Testimonies/Article-View/Article/567087/worldwide-threat-assessment/>.

<sup>8</sup> TRADOC Pamphlet 525-3-1, AOC, p. 14.

<sup>9</sup> Richard Fontaine and Julianne Smith, "Anti-Access/Area Denial Isn't Just for Asia Anymore," *Defense One*, April 2, 2015, p. 1, Retrieved on 4 December 2016, <http://www.defenseone.com/ideas/2015/04/anti-accessarea-denial-isnt-just-asia-anymore/109108/>.

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<sup>11</sup> Gen. Mark A. Milley, *Chief of Staff of the Army: Changing Nature of War Won't Change Our Purpose*, Association of the U.S. Army, October 1, 2016, p. 3, Retrieved on 3 December 2016, <https://www.ausa.org/articles/chief-staff-army-changing-nature-war-won%E2%80%99t-change-our-purpose>.

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<sup>13</sup> Fires Center of Excellence (FCoE), *Army Warfighting Challenge: Employ Cross-Domain Fires*, Army Capabilities Integration Center, December 2, 2016, p. 1, Retrieved on 15 January 2017, <https://www.milsuite.mil/wiki/AWFC>.

<sup>14</sup> Jon Harper, "Pentagon Pushing 'Multi-Domain Battle' Concept," *National Defense*, October 4, 2016, p. 2, Retrieved on 4 December 2016, <http://www.nationaldefensemagazine.org/blog/Lists/Posts/Post.aspx?ID=2319>.

<sup>15</sup> Sam LaGrone, "PACOM Commander Harris Wants the Army to Sink Ships, Expand Battle Networks," *USNI News*, February 21, 2017, p. 1, Retrieved on 20 March 2017, <https://news.usni.org/2017/02/21/pacom-commander-harris-wants-army-sink-ships-expand-battle-networks>.

<sup>16</sup> Eric Lindsey, "Beyond Coast Artillery: Cross-Domain Denial and the Army," *Center for Strategic and Budgetary Assessments*, October 29, 2014, p. 3, Retrieved on 29 November 2016, <http://csbaonline.org/research/publications/beyond-coast-artillery-cross-domain-denial-and-the-army/>.

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<sup>17</sup> Lindsey, p. 3-4.

<sup>18</sup> Sydney J. Freedberg, Jr., “Army’s ‘Multi-Domain Battle,’ Jamming, Hacking and Long Range Missiles,” *Breaking Defense*, September 27, 2016, p. 3, Retrieved on 29 November 2016, <http://breakingdefense.com/2016/09/armys-multi-domain-battle-jamming-hacking-long-range-missiles/>.

<sup>19</sup> Sydney J. Freedberg, Jr., “New Army Long-Range Missile Might Kill Ships, Too: LRPF,” *Breaking New Defense*, October 13, 2016, p. 1, Retrieved on 17 March 2017, <http://breakingdefense.com/2016/10/new-army-long-range-missile-might-kill-ships-too-lrpf/>.

<sup>20</sup> LaGrone, p. 1.

<sup>21</sup> Albert Palazzo, “Precision and the Consequences for the Modern Battlefield,” *Small Wars Journal*, August 19, 2016, p. 2, Retrieved on 14 March 2017, <http://smallwarsjournal.com/print/50126>.

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